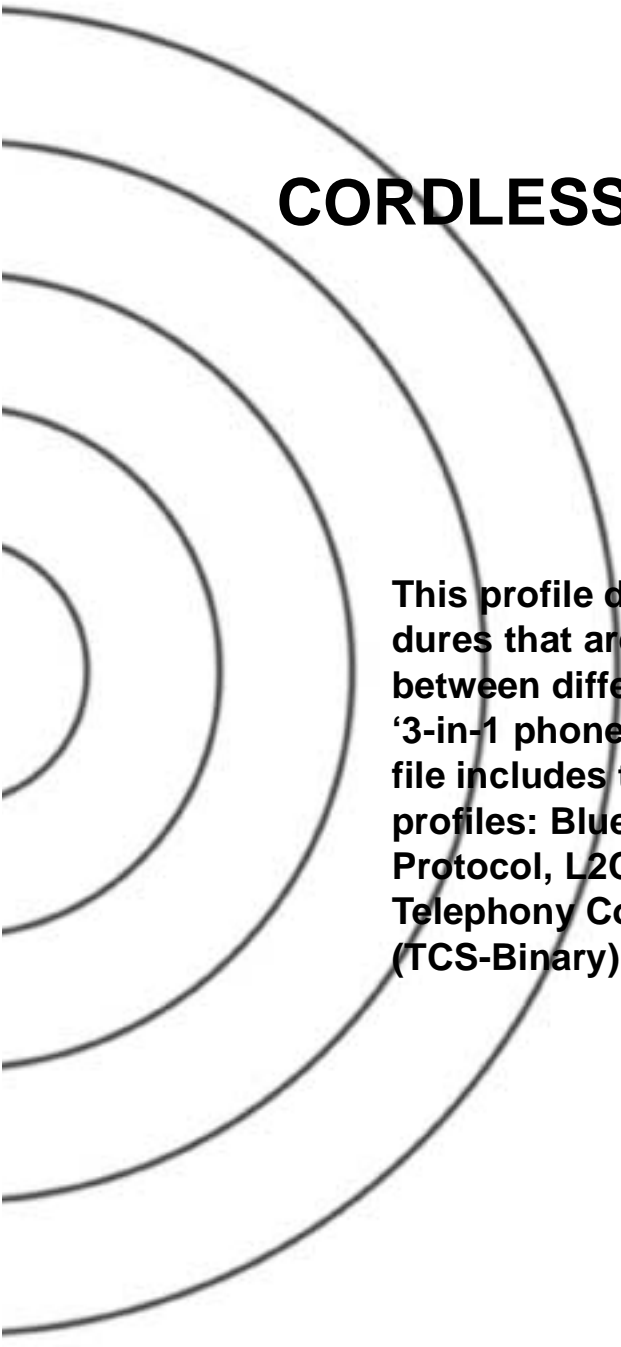# CORDLESS TELEPHONY PROFILE

This profile defines the features and procedures that are required for interoperability between different units active in the '3-in-1 phone' use case. The scope of this profile includes the following layers/protocols/profiles: Bluetooth Baseband, Link Manager Protocol, L2CAP, Service Discovery Protocol, Telephony Control Protocol Specification (TCS-Binary) and the General Access Profile.

CONTENTS

1 INTRODUCTION

1.1 SCOPE

The Cordless Telephony profile defines the protocols and procedures that shall be used by devices implementing the use case called '3-in-1 phone'.

The '3-in-1 phone' is a solution for providing an extra mode of operation to cellular phones, using Bluetooth as a short-range bearer for accessing fixed network telephony services via a base station. However, the 3-in-1 phone use case can also be applied generally for wireless telephony in a residential or small office environment, for example for cordless-only telephony or cordless telephony services in a PC – hence the profile name 'Cordless Telephony'.

This use case includes making calls via the base station, making direct intercom calls between two terminals, and accessing supplementary services provided by the external network.

1.2 PROFILE DEPENDENCIES

In Figure 1.1, the Bluetooth profile structure and the dependencies of the profiles are depicted. A profile is dependent upon another profile if it re-uses parts of that profile, by implicitly or explicitly referencing it. Dependency is illustrated in the figure. A profile has dependencies on the profile(s) in which it is contained – directly and indirectly. As indicated in the figure, the Cordless Telephony profile is dependent only upon the Generic access profile. The terminology, user interface and security aspects, modes and procedures as defined in the Generic access profile are applicable to this profile, unless explicitly stated otherwise.
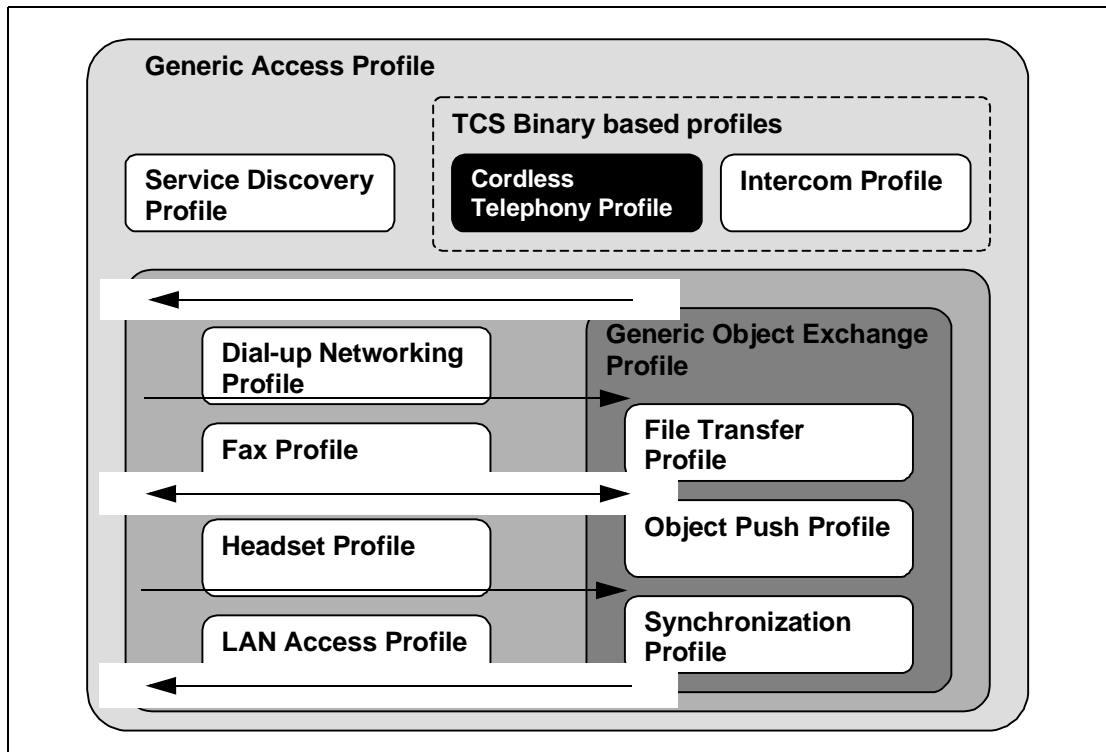
Figure 1.1: Bluetooth Profiles

1.3 SYMBOLS AND CONVENTIONS

1.3.1 Requirement status symbols

In this document, the following symbols are used:

'M' for mandatory to support (used for capabilities that shall be used in the profile);

'O' for optional to support (used for capabilities that can be used in the profile);

'C' for conditional support (used for capabilities that shall be used in case a certain other capability is supported);

'X' for excluded (used for capabilities that may be supported by the unit, but which shall never be used in the profile);

'N/A' for not applicable (in the given context it is impossible to use this capability).

Some excluded capabilities are capabilities that, according to the relevant Bluetooth specification, are mandatory. These are features that may degrade operation of devices following this profile. Therefore, these features shall never be activated while a unit is operating as a unit within this profile.

1.3.2 Signalling diagram conventions

The following arrows are used in diagrams describing procedures:

A		B
	PROC1	
	PROC2	
	PROC3	
	(PROC4)	
	(PROC5)	
	MSG1	
	MSG2	
	(MSG3)	
	(MSG4)	

In the table above, the following cases are shown: PROC1 is a sub-procedure initiated by B. PROC2 is a sub-procedure initiated by A. PROC3 is a sub-procedure where the initiating side is undefined (may be both A and B). PROC4 indicates an optional sub-procedure initiated by A, and PROC5 indicates an optional sub-procedure initiated by B.

MSG1 is a message sent from B to A. MSG2 is a message sent from A to B. MSG3 indicates an optional message from A to B, and MSG4 indicates an optional message from B to A.

1.3.3 Notation for timers and counters

Timers and counters may be introduced specific to this profile. To distinguish them from timers (counters) used in the Bluetooth protocol specifications and other profiles, these timers (counters) are named in the following format: 'T_{CTP}-*nnn*' ('N_{CTP}*nnn*').

2 PROFILE OVERVIEW

2.1 PROFILE STACK

Figure 2.1 below shows the protocols as used within this profile:
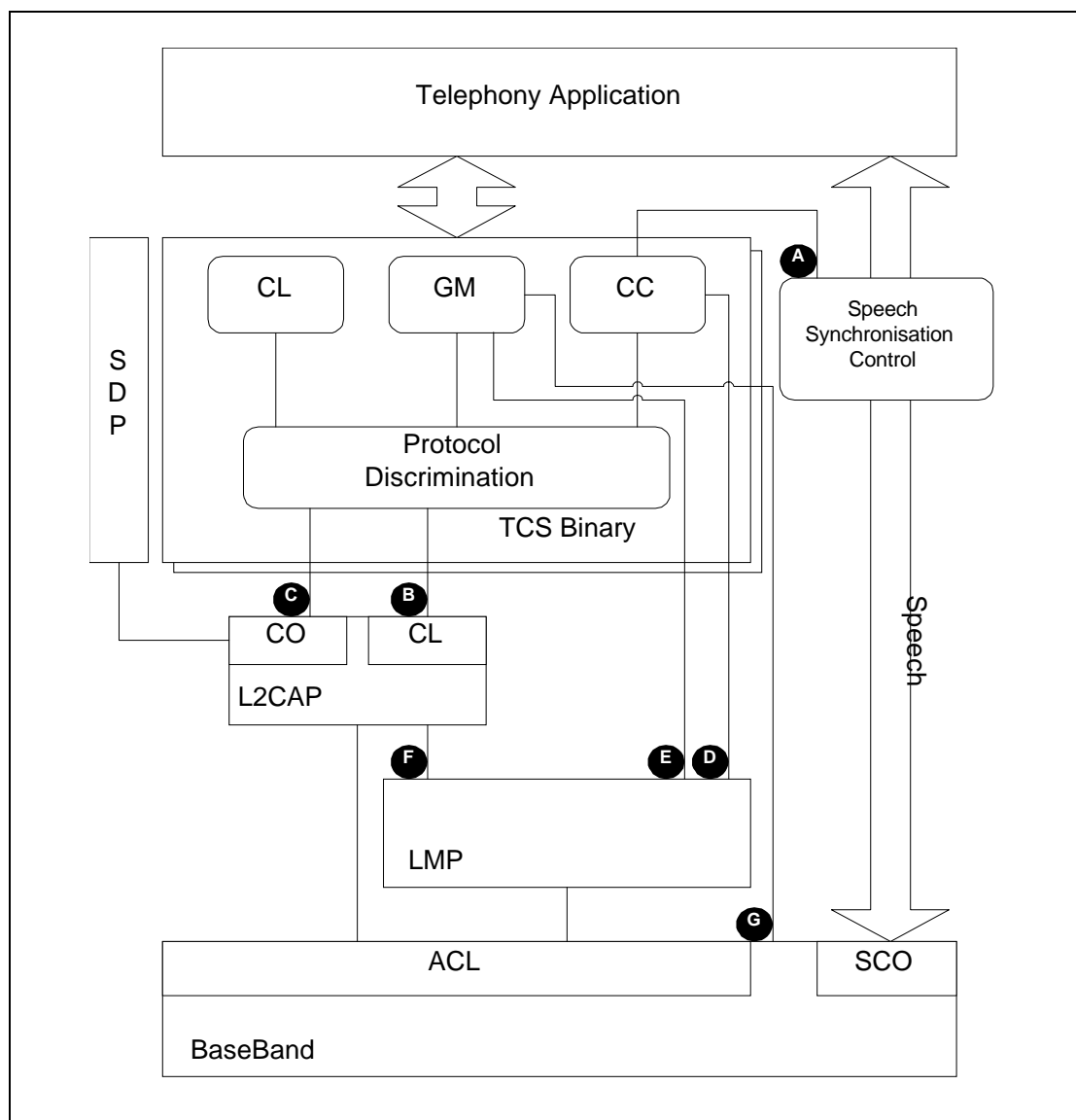
Figure 2.1: Protocol model

This profile will define the requirements for each of the layers in the model above for the Cordless Telephony profile.

In the profile, the interfaces in Figure 2.1 above are used for the following purposes:

A) The Call Control entity uses this interface to the speech synchronization control to connect and disconnect the internal speech paths.

B) This interface is used by the GW to send and by the TL to receive broadcast TCS-Binary messages.

C) This interface is used to deliver all TCS messages that are sent on a connection-oriented (point-to-point) L2CAP channel.

D) This interface is used by the Call Control entity to control the Link Manager directly for the purpose of establishing and releasing SCO links.

E) This interface is used by the Group Management to control Link Manager functions when initializing and for key handling purposes.

F) This interface is not within the scope of this profile.

G) This interface is used by the Group Management entity to control the LC/ Baseband directly to enable inquiry, paging, inquiry scan and page scan.

2.2   CONFIGURATIONS AND ROLES

The following two roles are defined for this profile:

Gateway (GW) – The GW acts as a terminal endpoint from the external network point of view and handles all interworking towards that network. The GW is the central point with respect to external calls, which means that it handles all call set-up requests to/from the external network. Examples of devices that can act as a gateway include a PSTN home base station, an ISDN home base station, a GSM gateway, a satellite gateway and an H.323 gateway.

With respect to this profile, the gateway may have the functionality to support multiple terminals being active at once, or be of a simple kind where only one terminal may be active. The simple gateway will not support multiple ringing terminals, multiple active calls or services involving more than one terminal simultaneously.

Terminal (TL) – The TL is the wireless user terminal, which may for example be a cordless telephone, a dual-mode cellular/cordless phone or a PC. Note that the scope of this profile with respect to a dual-mode cellular/cordless phone acting as TL is only the cordless mode.

The Cordless Telephony profile supports a topology of one gateway (GW) and a small number (≤7) of terminals (TLs)[1]. Figure 2.2 below shows an example of the considered architecture:
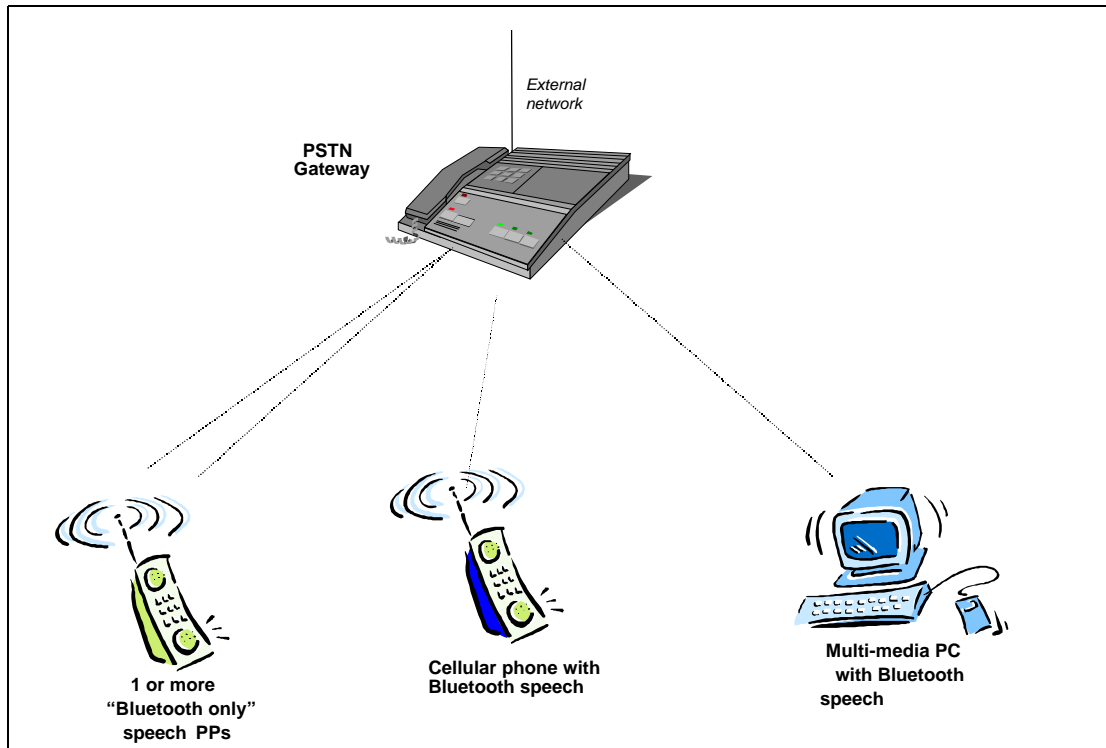
Figure 2.2: System configuration example

2.3 USER REQUIREMENTS AND SCENARIOS

The following scenarios are covered by this profile:

1. Connecting to the gateway so that incoming calls can be routed to the TL and outgoing calls can be originated.

2. Making a call from a TL to a user on the network that the gateway is connected to.

3. Receiving a call from the network that the gateway is connected to.

4. Making direct calls between two terminals.

5. Using supplementary services provided by the external network by means of DTMF signalling and register recall (hook flash).

---

1. Optionally, more terminals may be supported.

2.4 PROFILE FUNDAMENTALS

The GW is normally the master of the piconet in the Cordless Telephony pro-file. As master, the GW will control the power mode of the TLs and may broad-cast information to the TLs.

A TL that is out of range of a GW searches for it by periodically trying to page it. A GW shall devote as much of its free capacity as possible (considering power limitations and ongoing signalling) to page scanning in order to allow roaming TLs that enter the range of the GW to find it as quickly as possible. This scheme minimizes 'air pollution' and gives reasonable access time when com-ing into range of the GW. When a TL has successfully paged a GW, a master-slave switch shall be performed since the GW shall be the master. A connection-oriented L2CAP channel and, possibly, a L2CAP connectionless channel are established to be used for all TCS signalling during that Cordless Telephony session.

A TL that is within range of a GW shall normally be in park mode when it is not engaged in calls. This mode is power-efficient, allows for reasonable call set-up times and allows broadcasting to the attached TLs.

Upon arrival of an incoming call, or when a TL wants to make an outgoing call, the GW shall be put in active mode. The L2CAP channels (see above) are used for all TCS control signalling. Voice is transported using SCO links.

For security purposes, authentication of TLs and GW is used, and all user data is encrypted. To facilitate secure communication between cordless units, the WUG concept (see TCS Binary, Section 3) is used. The GW always acts as WUG master.

2.5 FEATURE DEFINITIONS

Calling line identification presentation (CLIP) – The ability to provide the calling party number to the called party before accepting the call.

Call information – The ability to provide additional information during the active phase of a call.

Connection Management – The ability to accept and (TLs only) request con-nections for the purposes of TCS-Bin procedures.

DTMF signalling – The ability, in external calls, to send a DTMF signal over the external network to the other party.

Incoming external call – A call originating from the external network con-nected to the GW.

Initialization – The infrequent process whereby a TL receives access rights to a certain GW.

Intercom call – A call originating from a TL towards another TL.

Multi-terminal support –

1. In the GW, the ability to handle multiple active terminals being registered at the same time[2]

2. In the TL, the support for a Wireless User Group (WUG)

On hook – The ability to indicate the action of going on-hook (e.g. to terminate a call), and release of all radio resources related to that call.

Outgoing external call – A call originated by a TL towards the external network connected to the GW.

Post-dialling – The ability to send dialling information after the outgoing call request set-up message is sent.

Register recall – The ability of the TL to request 'register recall', and of the GW to transmit the request to the local network. Register recall means to seize a register (with dial tone) to permit input of further digits or other actions. In some markets, this is referred to as 'hook flash'.

2.6 CONFORMANCE

If conformance to this profile is claimed, all capabilities indicated as mandatory for this profile shall be supported in the specified manner (process-mandatory). This also applies to all optional and conditional capabilities for which support is indicated. All mandatory capabilities, and optional and conditional capabilities for which support is indicated, are subject to verification as part of the Bluetooth certification program.

Note that the Intercom Profile is used for intercom calls. This means that a TL claiming conformance to the Cordless Telephony profile must conform to Intercom Profile.

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2. Note that a GW may support multiple active terminals but not a Wireless User Group (WUG).

3 APPLICATION LAYER

The following text, together with the associated sub-clauses, defines the feature requirements with regard to this profile.

Table 3.1 shows the feature requirements made by this profile.

Item no.	Feature	Support in TL	Support in GW
1.	Connection Management	M	M
2.	Outgoing external call	M	M
3.	Incoming external call	M	M
4.	Intercom call	M	N/A
5.	On hook	M	M
6.	Post-dialling	O	O
7.	Multi-terminal support	O	O
8.	Call information	O	O
9.	Calling line identification presentation (CLIP)	M	O
10.	DTMF signalling	M	M
11.	Register recall	M	M

Table 3.1: Application layer features

Table 3.2 maps each feature to the procedures used for that feature, and shows if the procedure is optional, mandatory or conditional for that feature. The procedures are described in the referenced section.

Feature	Procedure	Ref.	Support in TL	Support in GW
1. Connection Management	Connecting to a GW	4.1.1	M	M
	Connecting to a TL	4.1.2	M	N/A
2. Outgoing external call	Call request	4.2.3	M	M
	Overlap sending	4.2.4	C2	C2
	Call proceeding	4.2.5	C2	C2
	Call confirmation	4.2.6	M	O
	Call connection	4.2.7	M	M
	In-band tones and announcements	4.2.9	M	O

Table 3.2: Application layer feature to procedure mapping

Feature	Procedure	Ref.	Support in TL	Support in GW
3. Incoming external call	Call request	4.2.3	M	M
	Call confirmation	4.2.6	M	M
	Call connection	4.2.7	M	M
	Non-selected user clearing	4.2.8	M	M
	In-band tones and announcements	4.2.9	M	O
4. Intercom call	NOTE 1			
5. On hook	Call clearing	4.2.11	M	M
6. Post-dialling	Overlap sending	4.2.4	M	M
	Call proceeding	4.2.5	M	M
7. Multi-terminal support	Obtain access rights	4.4.1	M	O
	Configuration distribution	4.4.1	M	O
	Fast inter-member access	4.4.4	M	O
	Periodic key update	4.4.3	M	O
8. Call information	Call information	4.2.12	M	M
9. Calling line identification presentation (CLIP)	Calling line identity	4.3.2	M	M
10. DTMF signalling	DTMF signalling	4.3.1	M	M
11. Register recall	Register recall	4.3.3	M	M
C2: IF feature 6 THEN M else N/A				

Table 3.2: Application layer feature to procedure mapping

Note 1: For intercom calls, the intercom profile is used. Before initiating the intercom call, the TL which is initiating the call may optionally use the fast inter-member access procedure to speed up the call set-up.

4 TCS-BIN PROCEDURES

The following text together with the associated sub-clauses defines mandatory requirements with regard to this profile.

When describing TCS-BIN procedures, this section provides additional information concerning lower layer handling. The normative reference for TCS-BIN procedures is TCS Binary.

Annex A contains signalling flows that illustrate the procedures in this section.

4.1 CONNECTION MANAGEMENT

4.1.1 Connecting to a GW

When a TL connects to the GW, the link is configured and the L2CAP connection that is used for further signalling during that TCS-BIN session is set up and configured. The TL which is connecting is responsible for setting up the connection-oriented L2CAP channel.

Only trusted TLs are allowed to connect to the GW.

Note that, in order to avoid the paging delay at call set-up and to enable broadcasted messages, the TL establishes a L2CAP connection to the GW when it comes into range, and not before every call. This L2CAP connection remains until the radio link is lost or the TL stops being active in this profile. This means that the L2CAP connections used may be idle (i.e. not used to transfer data) for long periods of time.

A GW supporting feature 7, 'Multi-terminal support', uses a connectionless L2CAP channel for TCS-BIN broadcasted messages. A TL is added to the connectionless group when it connects to the GW.

4.1.2 Connecting to another TL

In the case of an intercom call, the TL which initiates the call establishes a direct link to the other TL. See the Intercom Profile for a description of these procedures.

If the TL has the capability to participate in two piconets at the same time, the TL may remain a member of the GW piconet and participate in signalling towards the GW during the intercom call.

If the TL does not have the capability to participate in two piconets at the same time, it must detach from the GW while the intercom call is active. After the intercom call is finished, the TL must re-establish the connection to the GW.

4.2 CALL CONTROL PROCEDURES

4.2.1 Sides

This section describes which sides shall be assumed for the purpose of reading TCS Binary.

In an outgoing external call, the TL is the outgoing side and the GW is the incoming side. In an incoming external call, the TL which terminates the call is the incoming side and the GW is the outgoing side.

Refer to the Intercom Profile for the sides assumed in intercom calls.

4.2.2 Call class

This section describes the usage of call classes in the Cordless Telephony profile.

An *external call* is a call between a TL and a third party connected via an external network (PSTN, ISDN, GSM or other). The call class used in SETUP messages for external calls (outgoing and incoming) is 'external call'.

An *intercom call* is a call between two TLs, which may be setup with GW support if the two TLs are members of the same WUG. Refer to Intercom Profile for call class usage in intercom calls.

4.2.3 Call request

This procedure shall be performed as defined in TCS Binary.

4.2.4 Overlap sending

This procedure shall be performed as defined in TCS Binary.

4.2.5 Call proceeding

This procedure shall be performed as defined in TCS Binary.

4.2.6 Call confirmation

This procedure shall be performed as defined in TCS Binary.

If the call is an incoming external call, and the SETUP message was delivered on a connection-oriented channel, the incoming side must acknowledge the SETUP message by performing the call confirmation procedure.

4.2.7 Call connection

This procedure shall be performed as defined in TCS Binary. The following text defines the mandatory requirements with regard to this profile.

If the bearer capability for this call is 'Synchronous Connection-Oriented', the SCO link establishment sub-procedure (see LMP, Section 3.21) shall be initiated before sending a CONNECT.

If the bearer capability for this call is 'Synchronous Connection-Oriented', the audio path shall be connected to by a unit when it receives a CONNECT or CONNECT ACKNOWLEDGE.

4.2.8 Non-selected user clearing

This procedure shall be performed as defined in TCS Binary. Additionally, the text in 4.2.11 defines the mandatory requirements with regard to this profile concerning call clearing.

4.2.9 In-band tones and announcements

This procedure shall be performed as defined in TCS Binary. The following text defines the mandatory requirements with regard to this profile.

Only the GW may provide in-band tones and announcements. The SCO link establishment sub-procedure (see Link Manager Protocol, Section 3.21) is initiated before sending a Progress Indicator information element #8, "In-band information or appropriate pattern is now available".

The audio path shall be connected to by a TL when it receives a Progress Indicator information element #8, "In-band information or appropriate pattern is now available".

4.2.10 Failure of call establishment

This procedure shall be performed as defined in TCS Binary. Additionally, the text in 4.2.11 defines the mandatory requirements with regard to this profile concerning call clearing.

4.2.11 Call clearing

All call clearing and call collision procedures as defined in TCS Binary shall be supported by both GW and TL. For a specification of the complete behavior, see TCS Binary. This section describes how the lower layers are used to release circuit switched (SCO) connections.

A unit shall release the SCO link by invoking the appropriate LMP sub-procedure (see Link Manager Protocol, Section 3.21) when a unit has received a RELEASE message.

A unit shall release the SCO link (if not already released) by invoking the appropriate LMP sub-procedure (see Link Manager Protocol, Section 3.21) when it has received a RELEASE COMPLETE message.

4.2.12 Call information

This procedure shall be performed as defined in TCS Binary.

4.3   SUPPLEMENTARY SERVICES

Supplementary services can be either internal services within the WUG, or external services provided by the network the GW is connected to.

The exact set of external supplementary services is not defined in this profile and is dependent on the network the GW is connected to. This profile provides the means for accessing them; for example through the use of DTMF signalling and register recall.

The required support for internal services and DTMF signalling is defined in the following sub-clauses.

4.3.1 DTMF signalling

The capability to request DTMF signalling towards the external network is mandatory for the TL. The capability to accept DTMF signalling requests is mandatory for the GW.

Depending on the network the GW is connected to, it shall translate the DTMF messages to the appropriate in-band or out-of-band signalling. If the network has no DTMF signalling capability, or if the GW for some reason is unable to perform DTMF signalling towards the external network, the GW shall reject the request for DTMF signalling as described below. In the START DTMF REJECT message, the GW shall use Cause #29, "Facilities rejected".

4.3.2 Calling line identity

This procedure shall be performed as defined in TCS Binary.

It is recommended that all GWs that are connected to networks that provide calling line identity have the capability to provide this information to the user.

4.3.3 Register recall

This procedure shall be performed as defined in TCS Binary.

4.4 GROUP MANAGEMENT PROCEDURES

4.4.1 Obtain Access Rights

This procedure shall be performed as defined in TCS Binary.

A TL which wants to become member of a WUG may initiate this procedure towards a GW. The GW may accept or reject the request depending, for example, on configuration, or if the user has physical access to the base.

A GW which accepts the access rights request shall add the TL to the WUG and initiate the Configuration distribution procedure.

4.4.2 Configuration distribution

This procedure shall be performed as defined in TCS Binary.

Because of the security implications of this procedure, a TL is not forced to store the key information received during this procedure. In addition, GW may always reject the ACCESS RIGHTS REQUEST from a TL because of implementation-dependent reasons. For example, the user may be required to press a button on the GW before being granted access to the group.

Note that for intercom calls, two TLs that are members of the WUG do not need to perform the initialization procedure described in the Intercom profile (see Intercom Profile) if they use the keys distributed in the Configuration distribution procedure.

A TL which stores link keys during the Configuration Distribution procedure shall never overwrite existing link keys to other WUG members. Only if there was previously no link key to a specific device shall the key obtained during the Configuration Distribution procedure be used.

In addition to the link-loss handling described in Section 4.8, Section 4.4.2.1 applies for this procedure.

4.4.2.1 Link loss detection by GW

If the GW detects loss of link before receiving the INFO ACCEPT message, it shall consider the WUG update to be terminated unsuccessfully and consider the TL detached. If the GW detects loss of link after receiving the INFO ACCEPT message, it shall consider the WUG update to be terminated successfully.

4.4.3 Periodic key update

The K_{master} to be used during a GW-TL connection is issued to the TL when connecting to a GW. The K_{master} is intended to be a key valid for a single session only, but since the GW piconet is operational all the time, this would mean that the same K_{master} would always be used. In order to increase the security level, the K_{master} is changed periodically.

Timer $T_{CTP}400$ determines the interval between key changes. When $T_{CTP}400$ expires, the GW tries to do a periodic key update on all TLs. However, some TLs may be out of range or powered off, or the procedure may fail for some other reason. The new key in these cases is given to the TL when it attaches the next time. After there has been an attempt to update all TLs, $T_{CTP}400$ is reset.

The periodic key update for one TL is performed as follows. First, if the TL was parked, it is unparked. Then, the new link key is issued. After this, the new link key is activated by turning encryption off and back on. Finally, the TL may be parked.

If any of the sub-procedures fails, further sub-procedures will not be performed on that TL. The GW shall proceed with updating the next TL.

4.4.4 Fast inter-member access

The Fast inter-member access procedure is used when two TLs that are members of the same WUG need to establish a piconet of their own. This may be needed when an intercom call shall be established. Refer to TCS Binary for a definition of the procedure.

The TL_T may detach from the GW after having sent the LISTEN ACCEPT message by terminating the L2CAP channel to the GW and sending a LMP_detach.

The TL_I may detach from the GW after having received the LISTEN ACCEPT message by terminating the L2CAP channel to the GW and sending a LMP_detach.

4.5 CONNECTIONLESS PROCEDURES

TCS-BIN Connectionless (CL) messaging is not within the scope of the Cordless Telephony profile.

4.6 TCS-BIN MESSAGE OVERVIEW

This section defines the required TCS-BIN messages in the Cordless Telephony profile.

Message	Ability to Send		Ability to Receive	
	TL	GW	TL	GW
Access rights accept	N/A	O	C1	N/A
Access rights reject	N/A	O	C1	N/A
Access rights request	C1	N/A	N/A	O
Alerting	M	O	M	M
Call Proceeding	C2	C2	M	M
Connect	M	M	M	M
Connect Acknowledge	M	M	M	M
Disconnect	M	M	M	M
Info suggest	N/A	O	C1	N/A
Info accept	C1	N/A	N/A	O
Information	M	O	O	M
Listen request	C1	N/A	N/A	O
Listen suggest	N/A	O	C1	N/A
Listen accept	C1	O	C1	O
Listen reject	C1	O	C1	O
Progress	N/A	O	M	N/A
Release	M	M	M	M
Release Complete	M	M	M	M
Setup	M	M	M	M
Setup Acknowledge	N/A	O	O	N/A
Start DTMF	M	N/A	N/A	M
Start DTMF Acknowledge	N/A	M	M	N/A
Start DTMF Reject	N/A	M	M	N/A
Stop DTMF	M	N/A	N/A	M
Stop DTMF Acknowledge	N/A	M	M	N/A
C1: IF feature 7 THEN M else N/A				
C2: IF feature 6 THEN M else N/A				

Table 4.1: TCS-BIN messages

4.7   INFORMATION ELEMENT OVERVIEW

This section together with the associated sub-clauses defines the required information elements used in TCS-BIN messages in the Cordless Telephony profile.

Information Element	Ability to Send		Ability to Receive	
	TL	GW	TL	GW
Message type	M	M	M	M
Audio control	N/A	N/A	N/A	N/A
Bearer capability	M	M	M	M
Call class	M	M	M	M
Called party number	M	O	O	M
Calling party number	O	C2	M	O
Cause	M	M	M	M
Clock offset	C1	O	C1	O
Company-specific	O	O	O	O
Configuration data	N/A	O	C1	N/A
Destination CID	N/A	N/A	N/A	N/A
Keypad facility	M	N/A	N/A	M
Progress indicator	N/A	O	M	N/A
SCO handle	M	M	M	M
Sending complete	M	N/A	N/A	M
Signal	N/A	M	M	N/A
C1: IF feature 7 THEN M else N/A				
C2: IF feature 9 THEN M else N/A				

Table 4.2: TCS-BIN information elements

The following subsections define restrictions that apply to the contents of the TCS-BIN information elements in the Cordless Telephony profile. Note that in the tables, only fields where restrictions apply are shown. If a field is not shown in a table, it means that all values defined in TCS Binary for that field are allowed.

For those information elements not listed below, no restrictions apply.

4.7.1 Bearer capability

The following restrictions apply to the contents of the Bearer capability information element:

Field	Values allowed
Link type	SCO, None

Table 4.3: Restrictions to contents of Bearer capability information element

4.7.2 Called party number

Maximum information element length is 27 octets, thus allowing a maximum of 24 number digits.

4.7.3 Calling party number

Maximum information element length is 28 octets, thus allowing a maximum of 24 number digits.

4.7.4 Cause

The following restrictions apply to the contents of the Cause information element:

Field	Values allowed
Cause value	#1 – "Unassigned (unallocated number)"
	#3 – "No route to destination"
	#16 – "Normal call clearing"
	#17 – "User busy"
	#18 – "No user responding"
	#19 – "No answer from user (user alerted)"
	#21 – "Call rejected by user"
	#22 – "Number changed"
	#26 – "Non-selected user clearing"
	#28 – "Invalid number format (incomplete number"
	#29 – "Facilities rejected"
	#34 – "No circuit/channel available"
	#41 – "Temporary failure"
	#44 – "Requested circuit/channel not available"
	#58 – "Bearer capability not presently available"
	#65 – "Bearer capability not implemented"
	#69 – "Requested facility not implemented"
	#102 – "Recovery on timer expiry"

Table 4.4: Restrictions to contents of Cause information element

4.8 LINK LOSS

If a unit in a CC state other than *Null* detects loss of link, it shall immediately go to the *Null* state. Release procedures shall in this case not be performed.

A unit in any GM state which detects loss of link shall consider itself to be in the null state. Any ongoing GM procedure shall immediately be aborted and considered to be terminated unsuccessfully.

5 SERVICE DISCOVERY PROCEDURES

Table 5.1 below lists all entries in the SDP database of the GW defined by this profile. The 'Status' column indicates whether the presence of this field is mandatory or optional.

The codes assigned to the mnemonic's used in the 'Value' column, and the codes assigned to the attribute identifiers, can be found in the Bluetooth Assigned Numbers (http://www.bluetooth.org/assigned-numbers.htm).

Item	Definition:	Type:	Value:	Status	Default
Service Class ID List				M	
Service Class #0		UUID	Cordless Telephony	M	
Service Class #1		UUID	Generic Telephony	O	
Protocol Descriptor List				M	
Protocol #0		UUID	L2CAP	M	
Protocol #1		UUID	TCS-BIN-CORDLESS	M	
Service Name	Display-able Text name	String	Service-provider defined	O	'Cord-less Tele-phony'
External Network		UInt8	0x01=PSTN 0x02=ISDN 0x03=GSM 0x04=CDMA 0x05=Analogue cellular 0x06=Packet-switched 0x07=Other	O	
BluetoothProfile-DescriptorList				M	
Profile #0		UUID	Cordless Telephony	M	
Parameter for Profile #0	Version	UInt16	0x0100[*]	O	0x100

Table 5.1: SDP entry for GW service

*. Indicating version 1.0

6 L2CAP PROCEDURES

The following text, together with the associated sub-clauses, define the mandatory requirements with regard to this profile.

6.1 CHANNEL TYPES

In this profile, both connection-oriented channels and connectionless channels are used.

Connectionless channels are used to broadcast information from the GW to the TLs. Only the GW shall use connectionless channels for sending. Refer to the Bluetooth Security Architecture White paper for information on the security implications of using L2CAP connectionless traffic.

In this profile, only the TL may initiate the establishment of connection-oriented channels. When connecting to the GW, the TL shall use the value 0x0007 (TCS-BIN-CORDLESS) in the PSM field of the Connection Request packet. For PSM usage in intercom calls, see Intercom Profile.

6.2 CONFIGURATION OPTIONS

This section describes the usage of configuration options in the Cordless Telephony Profile.

6.2.1 Maximum Transmission unit

The minimum MTU that a L2CAP implementation used for this profile should support is 171 octets. This means that the maximum number of TLs supported by this profile is 7.

6.2.2 Flush timeout option

The flush timeout value used for both the GW and the TL shall be the default value of 0xFFFF.

6.2.3 Quality of Service

Negotiation of Quality of Service is optional.

7 LMP PROCEDURES OVERVIEW

In this section the LMP layer is discussed. In the table below, all LMP features are listed. In the table it is shown what LMP features are mandatory to support with respect to the Cordless Telephony profile, which are optional and which are excluded. The reason for excluding features is that they may degrade operation of devices in this profile. Therefore, these features shall never be activated by a unit active in this profile.

	Procedure	Support in LMP	Support in TL	Support in GW
1.	Authentication	M		
2.	Pairing	M		
3.	Change link key	M		
4.	Change the current link key	M		
5.	Encryption	O	M	M
6.	Clock offset request	M		
7.	Slot offset information	O		
8.	Timing accuracy information request	O		
9.	LMP version	M		
10.	Supported features	M		
11.	Switch of master slave role	O	M	C1
12.	Name request	M		
13.	Detach	M		
14.	Hold mode	O		
15.	Sniff mode	O		
16.	Park mode	O	M	C1
17.	Power control	O		
18.	Channel-quality driven DM/DH	O		
19.	Quality of service	M		
20.	SCO links	O	M	M
21.	Control of multi-slot packets	O		
22.	Paging scheme	O		
23.	Link supervision	M		
24.	Connection establishment	M		
C1: IF feature 7 THEN M else N/A				

Table 7.1: LMP procedures

7.1 MASTER-SLAVE SWITCH

A GW supporting feature 7, 'Multi-terminal support', must always be the master of the piconet. Such a GW will request a master-slave switch when a TL connects. If the TL rejects the request, the GW may detach it. Thus, a TL which does not accept master-slave switch requests can not be guaranteed service by all GWs.

7.2 LINK POLICY

The GW shall be as conservative as possible when deciding what power mode to put the TLs in. This means that when a TL is not engaged in signalling, the GW shall put it in a low-power mode. The recommended low-power mode to use is the park mode.

The low-power mode parameters shall be chosen such that the TL can always return to the active state within 300 ms.

When the gateway does not support the Park mode (as indicated in the LMP_features message), it's up to the terminal how to maintain the link when not engaged in calls: either keep it in active mode, or release the link. After a link release, link re-establishment shall be initiated upon request, by either side. In this case, both gateway and terminal shall be in page scan mode when no active link is established.

If the GW can save power during a call, it may use the sniff mode. A TL may request to be put in the sniff mode.

7.3 ENCRYPTION KEY SIZE

In order to support encrypted broadcast messages, all devices in the profile must support an encryption key size of 5 octets.

8 LC FEATURES

The following table lists all features on the LC level.

	Procedure	Support in TL	Support in GW
1.	Inquiry		X
2.	Inquiry scan	X	
3.	Paging		C2
4.	Page scan		
A	Type R0		
B	Type R1		
C	Type R2		
5.	Packet types		
A	ID packet		
B	NULL packet		
C	POLL packet		
D	FHS packet		
E	DM1 packet		
F	DH1 packet		
G	DM3 packet		
H	DH3 packet		
I	DM5 packet		
J	DH5 packet		
K	AUX packet	X	X
L	HV1 packet		
M	HV2 packet		
N	HV3 packet	M	M
O	DV packet	X	X
6.	Inter-piconet capabilities	O	C1
7.	Voice codec		
A	A-law		
B	μ-law		
C	CVSD	M	M
C1: IF feature 7 THEN M else O			

Table 8.1: LC features

8.1 INQUIRY SCAN

A device which is active in the GW role of the Cordless Telephony profile shall, in the Class of Device field:

1. Set the 'Telephony' bit in the Service Class field

2. Indicate 'Phone' as Major Device class

This may be used by an inquiring device to filter the inquiry responses.

8.2 INTER-PICONET CAPABILITIES

Inter-piconet capability is the capability, as master, to keep the synchronization of a piconet while page scanning in free slots and allowing for new members to join the piconet. While a new unit is joining the piconet (until the master-slave switch has been performed), operation may temporarily be degraded for the other members.

A GW which supports feature 7, 'Multiple terminal support', shall have inter-piconet capabilities. The TL may have inter-piconet capabilities.

9 GENERIC ACCESS PROFILE INTEROPERABILITY REQUIREMENTS

This profile requires compliance to the Generic Access Profile.

This section defines the support requirements with regards to procedures and capabilities defined in Generic Access Profile.

9.1 MODES

The table shows the support status for Modes within this profile.

	Procedure	Support in TL	Support in GW
1	Discoverability modes		
	Non-discoverable mode	N/A	M
	Limited discoverable mode	N/A	O
	General discoverable mode	N/A	M
2	Connectability modes		
	Non-connectable mode	N/A	X
	Connectable mode	N/A	M
3	Pairing modes		
	Non-pairable mode	M	M
	Pairable mode	O	M

Table 9.1: Modes

9.2 SECURITY ASPECTS

The table shows the support status for Security aspects within this profile.

	Procedure	Support in TL	Support in GW
1	Authentication	M	M
2	Security modes		
	Security mode 1	X	X
	Security mode 2	C1	C1
	Security mode 3	C1	C1
C1: Support for at least one of the security modes 2 and 3 is mandatory.			

Table 9.2: Security aspects

9.3   IDLE MODE PROCEDURES

The table shows the support status for Idle mode procedures within this profile.

	Procedure	Support in TL	Support in GW
1	General inquiry	M	N/A
2	Limited inquiry	O	N/A
3	Name discovery	O	N/A
4	Device discovery	O	N/A
5	Bonding	M	M

Table 9.3: Idle mode procedures

9.3.1 Bonding

It is mandatory for the TL to support initiation of bonding, and for the GW to accept bonding.

10 ANNEX A (INFORMATIVE): SIGNALLING FLOWS

This annex contains signalling diagrams that are used to clarify the interworking between units. This annex is informative only. The diagrams do not represent all possible signalling flows as defined by this profile.

10.1 OUTGOING EXTERNAL CALL WITHOUT POST-DIALLING

The following sequence shows the successful case when the TL does not use overlap sending:

```
TL                                                   GW
                     SETUP
        ========================>
                (CALL PROCEEDING)
        <========================
                  (ALERTING)
        <========================
             SCO LINK ESTABLISHMENT
        <--------------------------------------
                   CONNECT
        <========================
             CONNECT ACKNOWLEDGE
        ========================>
```
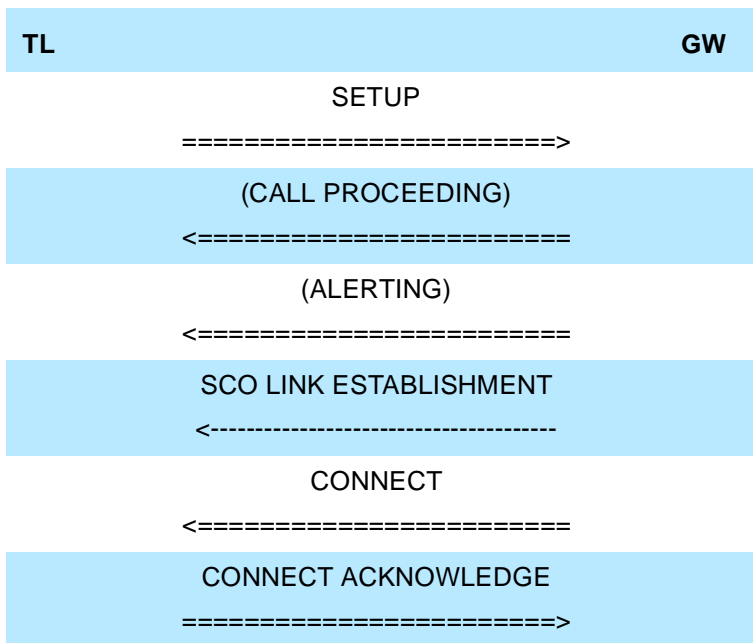
Figure 10.1: TL-originated call when overlap sending is not used

10.2 OUTGOING EXTERNAL CALL WITH POST-DIALLING

The following sequence shows the successful case when post-dialling is used.

TL		GW
	SETUP =========================>	
	SETUP ACKNOWLEDGE <=========================	
This message is repeated until the GW has enough dialling information	INFORMATION =========================>	
	(CALL PROCEEDING) <=========================	When the GW has sufficient information to complete the call, CALL PROCEEDING, ALERTING or CONNECT is sent.
	(ALERTING) <=========================	
	SCO LINK ESTABLISHMENT <--------------------------------------	
	CONNECT <=========================	
	CONNECT ACKNOWLEDGE =========================>	

Figure 10.2: Outgoing external call with post-dialling

10.3   INCOMING EXTERNAL CALL, SETUP DELIVERED ON CONNECTIONLESS CHANNEL

The figure below shows the allowed signalling flow in the successful case:

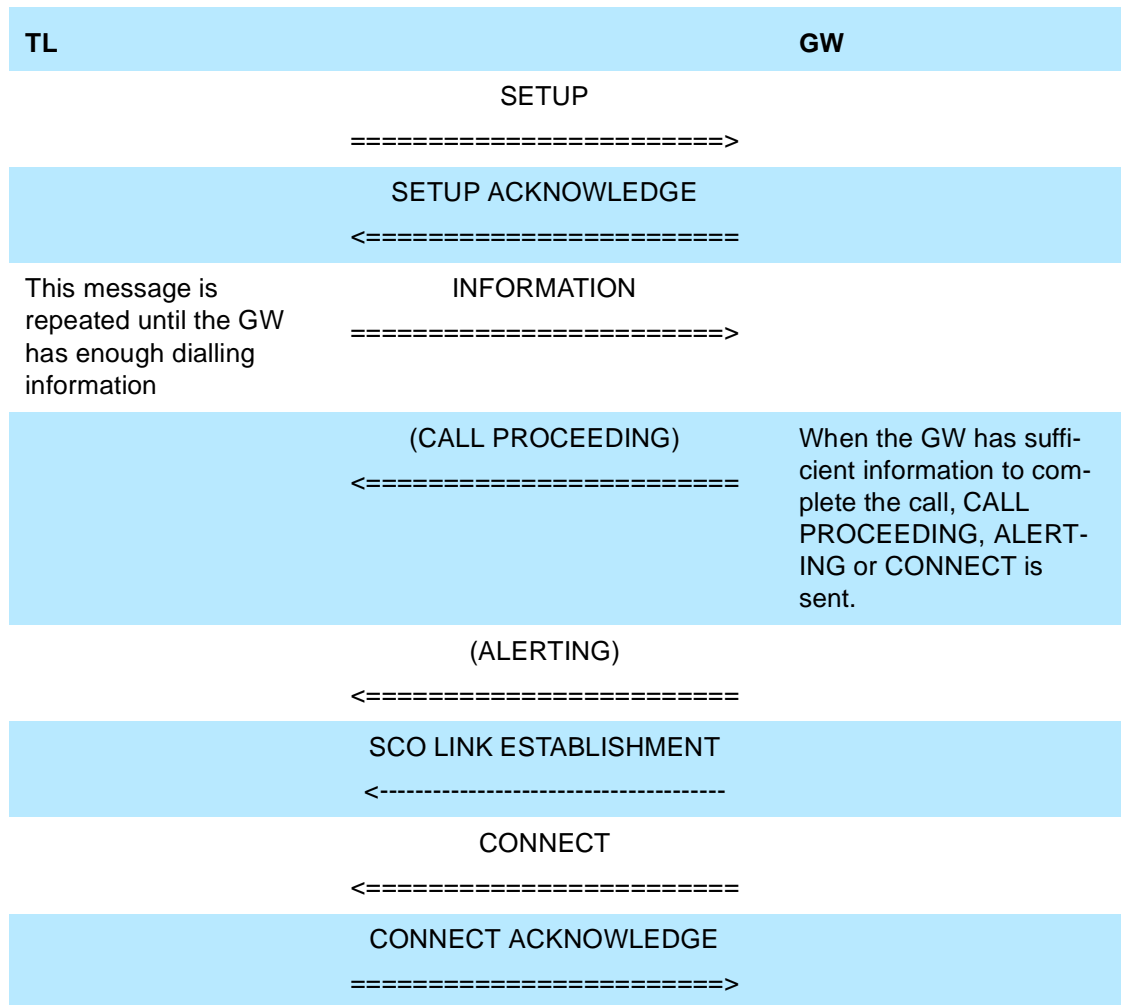| TL	GW
SETUP	
<======================	
(UNPARK)	
--------------------------------------->	
SCO LINK ESTABLISHMENT	
--------------------------------------->	
CONNECT	
=======================>	
CONNECT ACKNOWLEDGE	
<======================	
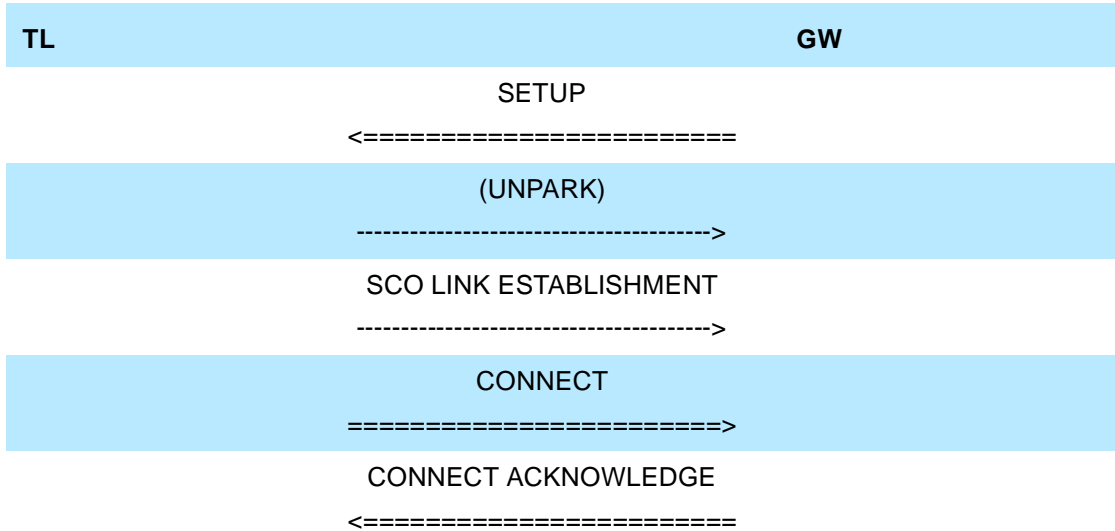
Figure 10.3: Incoming external call, SETUP delivered on connectionless channel

10.4   INCOMING EXTERNAL CALL, SETUP DELIVERED ON CONNECTION-ORIENTED CHANNEL

The figure below shows the allowed signalling flow in the successful case:

TL	GW
SETUP	
<=======================	
(UNPARK)	
--------------------------------------->	
ALERTING	
=======================>	
SCO LINK ESTABLISHMENT	
--------------------------------------->	
CONNECT	
=======================>	
CONNECT ACKNOWLEDGE	
<======================	

Figure 10.4: Incoming external call, SETUP delivered on connection-oriented channel

10.5 CALL CLEARING
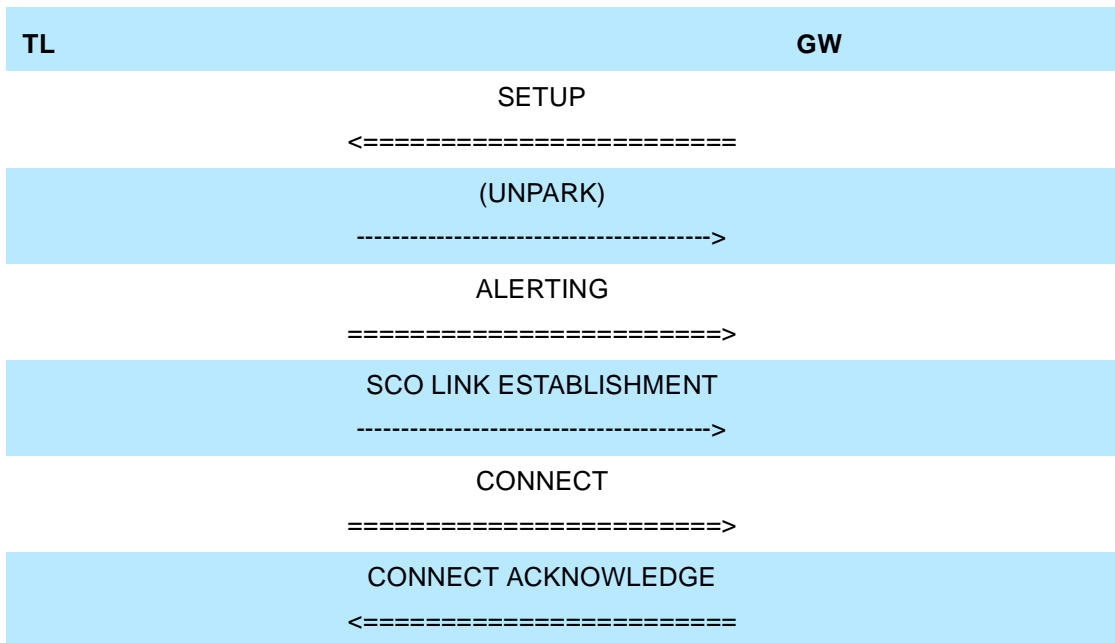
The figure below shows the allowed signalling flow in the successful case when the TL initiates call clearing:
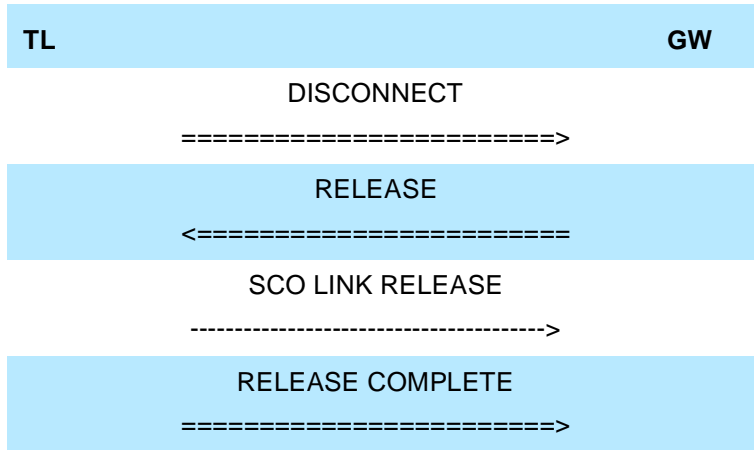
TL	GW
DISCONNECT	
=======================>	
RELEASE	
<======================	
SCO LINK RELEASE	
--------------------------------------->	
RELEASE COMPLETE	
=======================>	

Figure 10.5: Call Clearing signalling flow, successful case

10.6 DTMF SIGNALLING

The figure below shows the allowed signalling flow in the successful case:

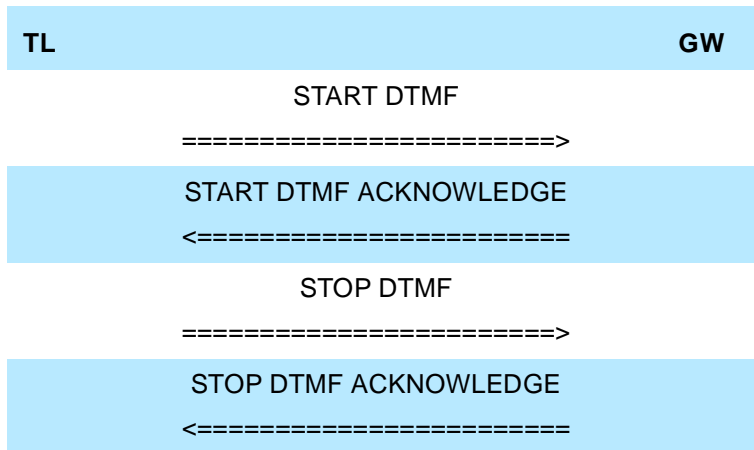| TL	GW
START DTMF	
=========================>	
START DTMF ACKNOWLEDGE	
<======================	
STOP DTMF	
=========================>	
STOP DTMF ACKNOWLEDGE	
<======================	

Figure 10.6: DTMF signalling, successful case

10.7 DTMF SIGNALLING FAILURE

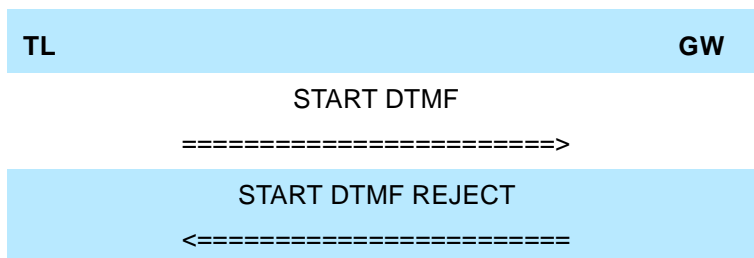The figure below shows the allowed signalling flow in the unsuccessful case:

TL	GW
START DTMF	
=========================>	
START DTMF REJECT	
<======================	

Figure 10.7: DTMF signalling, unsuccessful case

10.8 ACCESS RIGHTS REQUEST

The figure below shows the allowed signalling flow in the successful case:

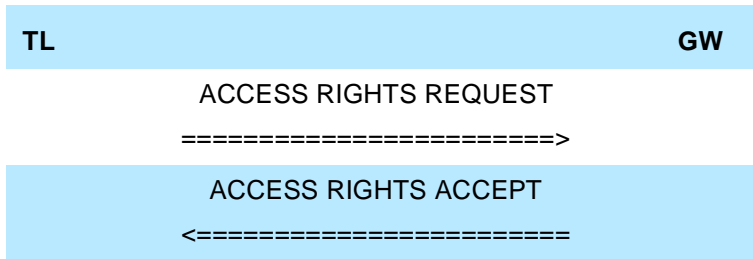| TL	GW
ACCESS RIGHTS REQUEST	
=========================>	
ACCESS RIGHTS ACCEPT	
<=======================	

Figure 10.8: Signalling diagram for Access Rights Request

10.9 CONFIGURATION DISTRIBUTION

The figure below shows the allowed signalling flow in the successful case:

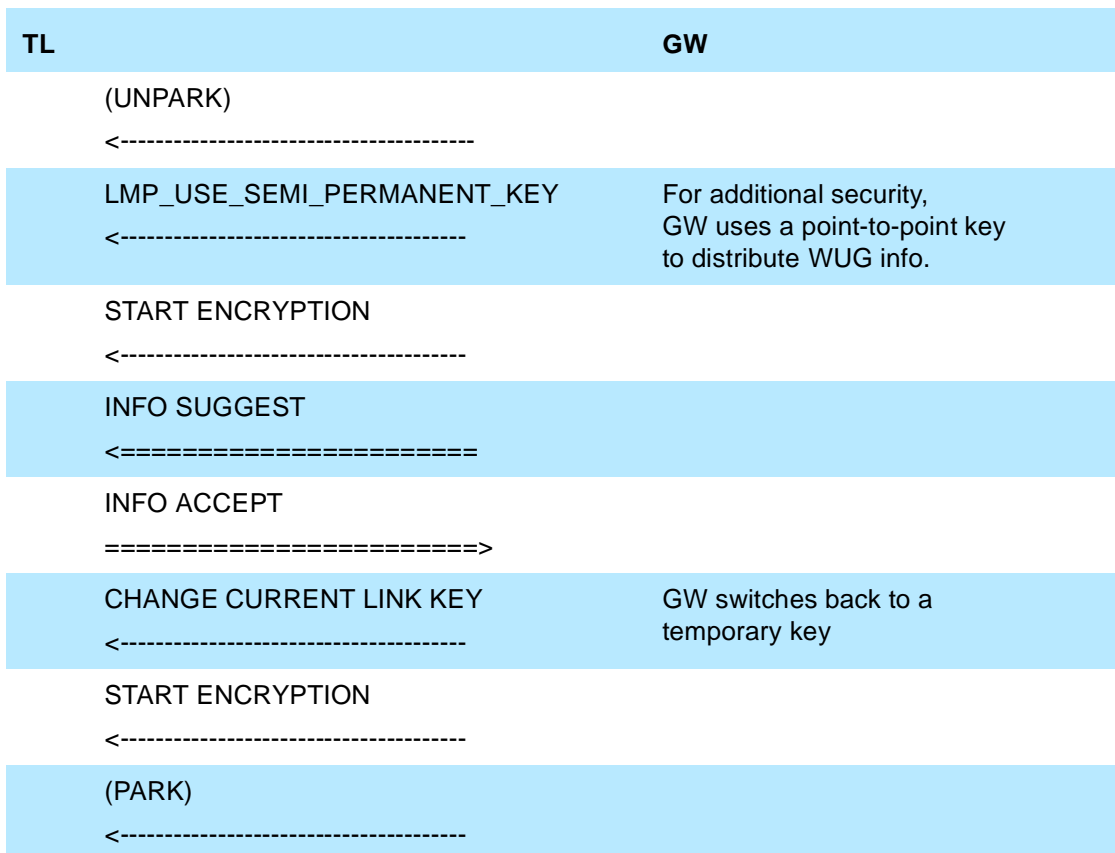| TL	GW
(UNPARK)	
<--------------------------------------	
LMP_USE_SEMI_PERMANENT_KEY	For additional security, GW uses a point-to-point key to distribute WUG info.
<--------------------------------------	
START ENCRYPTION	
<--------------------------------------	
INFO SUGGEST	
<=======================	
INFO ACCEPT	
=========================>	
CHANGE CURRENT LINK KEY	GW switches back to a temporary key
<--------------------------------------	
START ENCRYPTION	
<--------------------------------------	
(PARK)	
<--------------------------------------	

Figure 10.9: Signalling diagram for Configuration distribution

10.10 PERIODIC KEY UPDATE

The figure below shows the allowed signalling flow in the successful case:

```
┌────────────────────────────────────────────────────┐
│ TL                                                GW │
└────────────────────────────────────────────────────┘
                        (UNPARK)
        <-------------------------------------
┌────────────────────────────────────────────────────┐
│           CHANGE THE CURRENT LINK KEY                │
│                                                      │
│        <-------------------------------------        │
└────────────────────────────────────────────────────┘
                   TURN OFF ENCRYPTION
        <-------------------------------------
┌────────────────────────────────────────────────────┐
│                 TURN ON ENCRYPTION                   │
│                                                      │
│        <-------------------------------------        │
└────────────────────────────────────────────────────┘
                         (PARK)
        <-------------------------------------
```
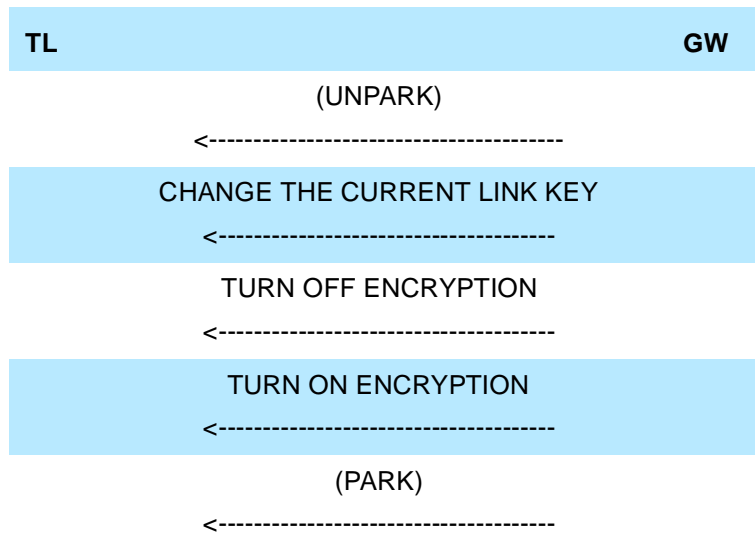
Figure 10.10: Signalling diagram for periodic key update

10.11 FAST INTER-MEMBER ACCESS

The figure below shows the allowed signalling flow in the successful case:

```
┌────────────────────────────────────────────────────┐
│ TL_O                                              GW │
└────────────────────────────────────────────────────┘
                        (UNPARK)
        ------------------------------------->
┌────────────────────────────────────────────────────┐
│                  LISTEN REQUEST                      │
│                                                      │
│        =========================>                    │
└────────────────────────────────────────────────────┘
                    LISTEN ACCEPT
        <=========================
┌────────────────────────────────────────────────────┐
│              (L2CAP CHANNEL RELEASE)                 │
│                                                      │
│        ------------------------------------->        │
└────────────────────────────────────────────────────┘
                        (DETACH)
        ------------------------------------->
```
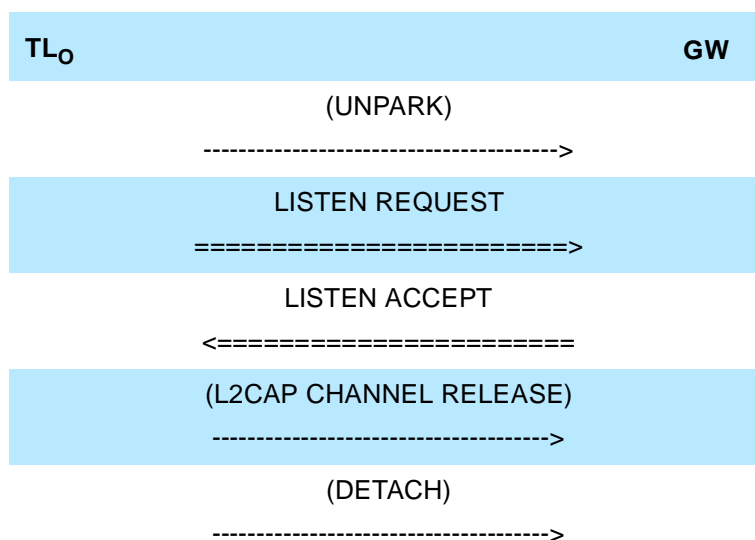
Figure 10.11: Signalling diagram for Fast inter-member access, originating side

The figure below shows the valid sub-procedure sequence between the TL$_T$ and GW:
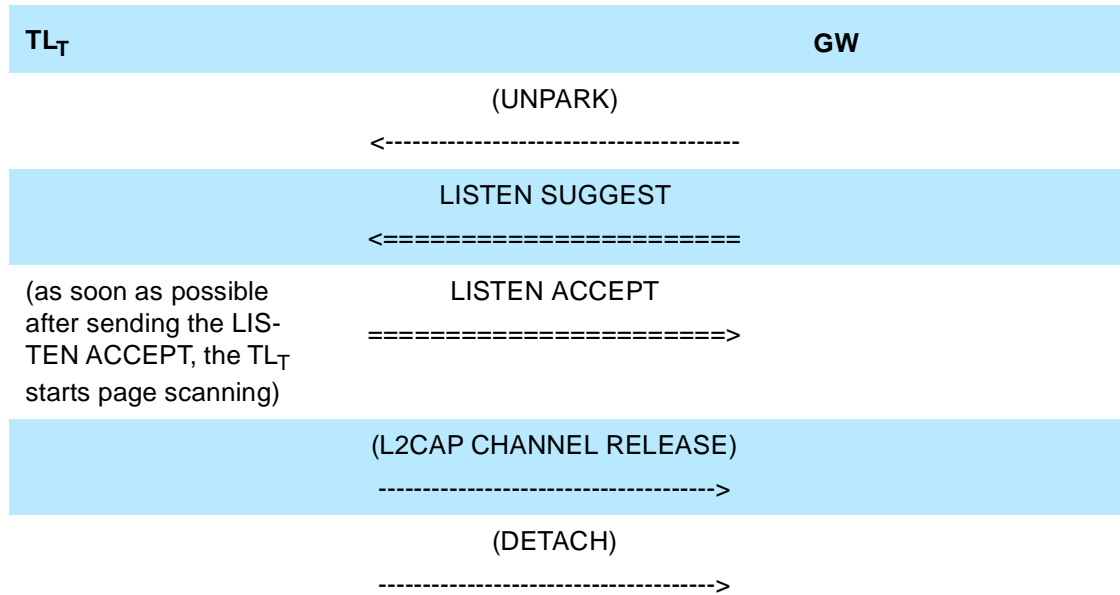
TL$_T$		GW
	(UNPARK)	
	<--	
	LISTEN SUGGEST	
	<==========================	
(as soon as possible after sending the LIS-TEN ACCEPT, the TL$_T$ starts page scanning)	LISTEN ACCEPT ==========================>	
	(L2CAP CHANNEL RELEASE) -------------------------------------->	
	(DETACH) -------------------------------------->	

Figure 10.12: Signalling diagram for Fast inter-member access, terminating side

11 TIMERS AND COUNTERS

Timer name	Proposed value	Description	Comment
$T_{CTP}400$	1 week	Time between periodic key updates, depending on the required security level	

Table 11.1: Defined timers

12 REFERENCES

[1]   Bluetooth Baseband Specification

[2]   Bluetooth Link Manager Protocol

[3]   Bluetooth Logical Link Control and Adaptation Protocol Specification

[4]   Bluetooth Telephony Control Protocol Specification

[5]   Bluetooth Service Discovery Protocol

[6]   Bluetooth Intercom Profile

[7]   Bluetooth Assigned Numbers
       http://www.bluetooth.org/assigned-numbers.htm

[8]   Thomas Müller, Security Architecture Whitepaper, version 0.5

13 LIST OF FIGURES

14 LIST OF TABLES